SUPPLEMENT.

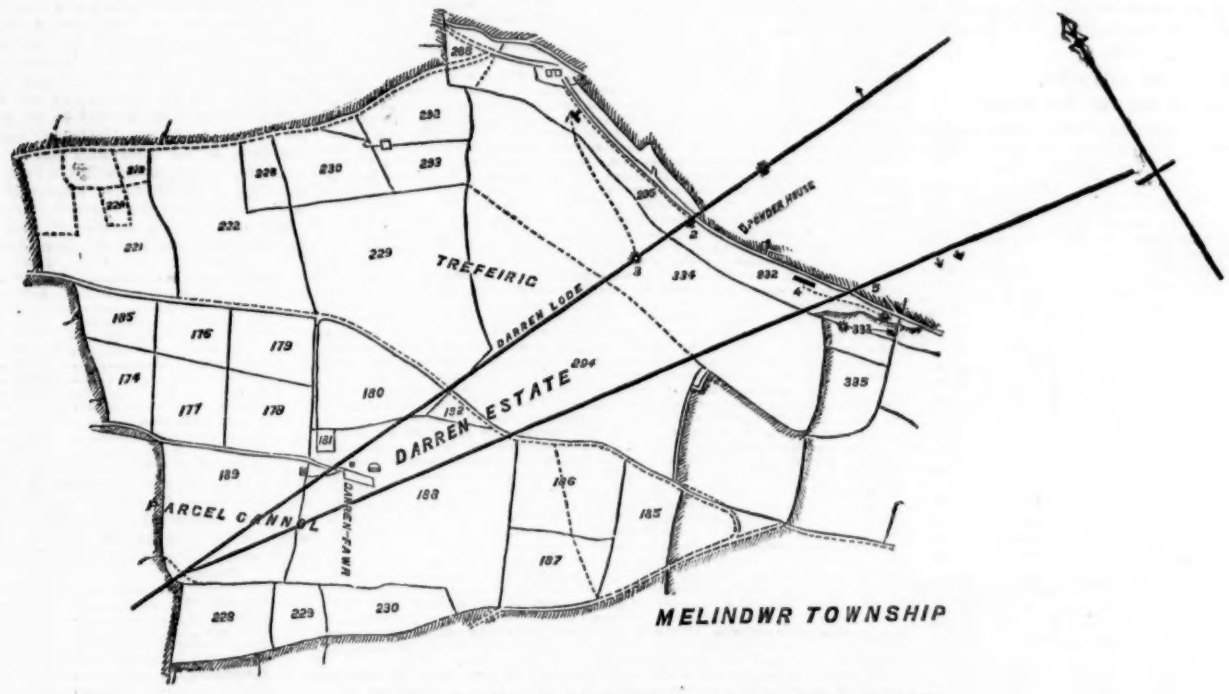
The Mining Journal,

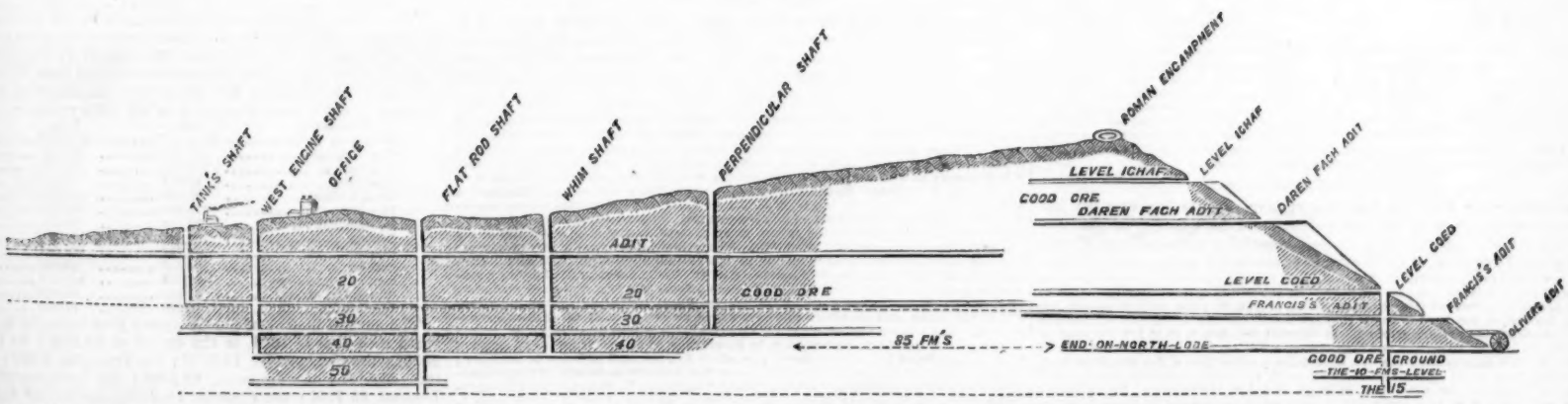
RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

No. 1551.—Vol. XXXV.] LONDON, SATURDAY, MAY 13, 1865. STAMPED.... SIXPENCE. UNSTAMPED. FIVEPENCE.

THE GREAT DARREN MINING DISTRICT, NORTH WALES.





Some discussion having latterly occurred as to the extent of the Darren resources, we have procured maps of undoubted authenticity, that were made for the purpose of settling questions in property affected by the Tithe Commutation Act throughout the country. These maps have been tried by comparison with the Ordnance Survey, and they have proved to be so accurate that they are generally accepted as a basis for fixing the rights of the land proprietors, and, indeed, held as ground plans of the property of the country. Upon these plans we have caused to be marked the two great mineral veins running through our grant; one of them, being the northernmost, is the Great Darren vein, while the southernmost is the far-famed Cwmsymlog lode, a vein celebrated in all time, and it is the one that is worked as the main lode in South Darren. It is a fact that is quite patent, that the fame of the Great Darren lode has not only caused the mine to be referred to as one of the most remarkable silver-lead veins ever worked in the country, but most of the surrounding mines have changed their names in deference to it; thus the Great Cwmsymlog of Sir Hugh Myddelton is now called the East Darren Mine; and Cwmsebon, a mine of some consequence, not long ago changed its name from Cwmsebon to that of the South Darren Mine. This alone is sufficient to stamp the Great Darren Silver-Lead Mine as one of no ordinary character or pretensions. The resources of all mines are computed from certain phenomena connected with them. The general data are the length of the ore deposits, which, again, depends on the length of lode within the grant; but the great element that enters into the calculation is the richness of the lodes, or, in other words, the quantity of ore or metallic value that is contained in a certain admeasurement, which, in mining, is generally estimated by the fathom—the fathom meaning 6 feet square, or 36 square feet is taken upon the face or superficies of the vein, irrespective of its width, so that if a lode were 6, 12, or 18 feet wide, it would only be considered 1 fathom on the lineal admeasurement of the vein, although that might really amount to 2, 3, or more cubic fathoms. The Great Darren lode averages from 6 feet up to 20 feet in width; its rock may be excavated for about 20s. to 25s. per cubic fathom, as an average; and the cubic fathom of this great lode usually contains 10 cwts. of rich silver-lead ore, producing 30 ozs. to 32 ozs. of silver to the ton, or about 10*l.* worth of ore. We see from these elements that about 2 cubic fathoms of the lode contain about 20*l.* worth of ore, and this may be taken away for about 2*l.* 10s., or, in mining phraseology, 2s. 6d. in 1*l.* sterling. The length of this great lode, it will be seen by referring to the section herewith presented, occupies a space of 1000 yards in length, in round numbers 00 fathoms. It is worked away for 70 fathoms deep, which is a superficial area of 35,000 fathoms, which, at 20*l.* per fathom, would represent the ore that has been worked away to be worth, in round numbers, 700,000*l.*; and if we take one-quarter of it as the remunerative proportion, it would have afforded profits to the extent of nearly 180,000*l.* It would not be stretching the probabilities connected with this mine if, from analogy, we estimate that the next 200 fathoms in depth will give three times this amount, or 540,000*l.*, which, divided over 20 years, gives 27,000*l.* a year in profits. Of course we know, in dealing with matters of this kind, great allowances must be made for contingencies, but we hold it is better to give an estimate that throws some light upon the value of a great property like this, than, from sheer timidity, or fearfulness of our own power of grappling with the future, to leave the question in entire darkness; and if we look at the produce of Goginan and some other mines in the neighbourhood, we shall see that the apparent vastness of the speculative element in the calculation is condensed into small proportions by the reality; for instance, a piece of the Goginan lode, 60 fathoms long above the adit, from 60 fathoms high, yielded for every fathom on the wall of the lode 60*l.* worth of ore, or nearly 220,000*l.* worth of lead and silver, from a piece of ground of only between 3000 and 4000 square fathoms. In this calculation we have said nothing of the Great Cwmsymlog lode, which runs through this ground for nearly the same distance as the Darren lode, and in the eastern end of the sett, near the eastern boundary, contains more metallic value by the fathom, consisting of lead, copper, and silver, than the Great Darren lode itself. The next question is—"Are we mining the ground fairly and scientifically, in a practical point of view?" because if we are not doing that we had better be doing nothing, and all our labour is being thrown away, or being rendered useless for any solid advantages that ought to be obtained from the mine. In this respect our armour ought to be proof against every attack, either coming from without or within. In order to be safe on this point and bearing of the question, when we commenced operations in this mine we took counsel of several of the best mining engineers in the district, and the verdict was unanimous that we should sink down the shaft 30 fathoms west of the boundary, on the eastern deposit of copper and silver ore. This we have done, until we have reached a point a little below the lowest working in the old mine; nor, as was predicted, have our efforts been unattended with success, for we have been sinking in a fine course of ore from the very surface to the 15 fathom level, under Oliver's adit, which is the very bottom of the mine, and the deepest point in it either eastward or westward, or throughout the body of the workings. We have taken away 20 fathoms lengthwise on the body of the lode at this stage of our operations, and found them to leave a good residuum, or balance, in the shape of profit. This, of itself, is a very valuable consideration, but it becomes of more material value when we take with it the fact that these workings are under the bottom, or deepest part of the old mine, and that by continuing them horizontally to the westward we can unwater the whole of these immense workings by means of them; and more than that, we have our pumping machinery erected and at work for the purposes of drainage, and powerful machinery applied for clearing the bargains of the orestuff as it is broken, and for crushing, washing, and sending the cleansed ore to market. It will be patent to everybody who knows anything of mining that these underground works—the arrangements for draining, the machinery for drawing, crushing, and washing the ore—could not be applied for a sum of less than several thousands of pounds, and an amount of time that is almost invaluable; for if we had to begin to do all this work over again, and to arrive from a beginning to the present stage of our workings, we should look upon the money as far less valuable than the amount of time required to carry out such laborious and tiresome operations; we say tiresome, because no amount of ingenuity could facilitate the rate of progress in such works to that degree that they should keep pace with expectations formed at the commencement of them, when everybody connected was naturally eager to get at the desired ore ground. It must be admitted that, all this being done, there is still a wide field open on which to exercise patience. The fastest mode of getting through the rock in the bottom of the mine is very slow, not more than 3 or 4 fms. a month; and it consequently takes a long time to deal with ore ground of such great length. In this respect the Darren Mine may be said to be the most tedious or time-requiring mine in the district, for the extent of its deposit of ore is so great that it seems almost unbroken for a length of upwards of ½ mile. It is true that once we have one pioneer level through it the next will follow so expeditiously, and everything will go on with such speed and regularity, as if the whole workings were only of limited extent, for one level will succeed another with such rapidity that all the ore ground may be occupied advantageously without any apparent delay, for the engine-shaft will be kept sinking, and levels be taken up and carried westward from it without intermission. Even this summer we intend to deepen the shaft to the 30, which will be 20 fms. below the longest range of the deepest old workings; and, as this season of the year is peculiarly adapted to this sort of work, the sinking of the engine-shaft will be proceeded with at once.

There is another point of some consequence in the question of the value

of the mine. We have stated the quality of the eastern ground, as seen in the shaft and level, made by ourselves, and we naturally enquire what evidence is there that the great remaining portion of the lode wrought by the old men is of such worth as it is stated to be? Upon this point we have evidence of living witnesses, who saw the western part of the old workings unwatered, nearly 30 years ago, and they pronounce the very westernmost part of the ground, about the old engine-shaft, in the western part of the mine, to be of greater value per fathom than the eastern ground; and as to the middle of the mine, its value is known, for it was from this portion of the sett that, 120 years ago, a Flintshire Mining Company made 7000*l.* a year profit. It is, therefore, pretty evident—indeed, quite as evident as proofs of this class usually are, or, indeed, more so—that the whole line of ore ground throughout this great mine will prove to be of a highly profitable character. We believe now that every question of importance with reference to this mine is candidly placed before the public. The object of procuring the maps, and going so thoroughly into the present business of the mine, and looking as far as may be into the future prospects, is to submit a class of facts, and the reasoning upon them, connected with mining in general, and this mine in particular, that do not naturally and readily present themselves. To those who do not make mining their chief pursuit, or principal business of life, as well as in order to take off the tedium inherent on a long line of tunnelling carried through hard rock, such considerations form food for those who are constitutionally impatient, and an answer to those who are adroit in putting puzzling questions, and enjoy a gleeful delight in doing irrelevant mischief, taking little pleasure in good; for we must not blind ourselves to the fact that there are such people connected with all good schemes, although, perhaps, it may not appear very charitable or very wise to say so here. All we can say, however, is that we wish we could bore through the rock faster, so as to lay the result of our labours, in the shape of large dividends, at the feet of our proprietors at a period earlier than by the natural course of events we shall be able to do. We have, however, pleasure in promising the proprietary of this mine that not a stone shall be left unturned in order to prove that we are thoroughly in earnest in prosecuting and pressing on the works we believe which are to lead to the great result that we are so anxiously expecting. No better evidence can be adduced as to the *bona fides* of this property, than the fact that the manager himself holds two-thirds of the mine; and this is also a guarantee that the conduct of these great works will receive all the attention it is possible to devote; for if self-interest be not the main-spring of prosperity, we hold that, at least for some time, it will puzzle the world to discover it.

THE SILVER MINES OF NEVADA.

INTERESTING ACCOUNT OF A TRIP THROUGH THE SHAFTS.

The Virginia City (Nevada) Journal gives the following description of the silver mines near that place, and the underground villages and steam-engines, railroad cars, and other appliances of underground life:—

Descending at the Chollar Works by a perpendicular shaft, over 400 ft. in depth, one may wander off in almost any direction. By two or three different roads we might travel eastward nearly half a mile, finally coming out to the light of day in the south-western suburbs of the city, among the mills and miners' cabins; but we will take another course. Leaving the village of the Chollarites, we travel northward. Along the sides of the narrow streets are glimmering lights—some twinkling far ahead, like distant stars, and others flashing suddenly upon us as we turn the corners, with a blinding affluence of light. As we proceed with our journey we meet with many picturesque groups of miners at their labours. Here they are delving out chambers in the precious silver rock, and there hoisting into place the stout timbers that are to support the mountain and the city above. We pass through roomy caverns, whose space robs our candles of light, and in whose walls yawn gloomy galleries, leading we know not whither, and about and within whose black portals cubic pyrites and brilliant quartz crystals flash back the light of our candles in a thousand merry glow-worm twinkles. After passing through subterranean villages of divers mining companies, we come to the thriving settlement of the savage people. Having halted in their hospitable hamlet long enough to make some enquiries relative to our road to the next village, the home of the Gould and Curry tribe, we take our leave and pursue our journey. In our course we see many wonders, meet with numerous adventures, and encounter many a solitary traveller—but not a "solitary horseman"—walk on the brink of more than one yawning chasm, and experience numerous and mixed sensations; but finally reach the Gould and Curry clan in safety. We find them quite a civilised people. Although more than 400 ft. below the street of the city, we here find a large building with a huge steam-engine in it, puffing away as comfortably as though there were no surface to the earth, with green trees, singing birds, and the sun shining upon all and everywhere. We enter the building, take a seat, sip a glass of champagne, light a cigar, and, as we watch its curling smoke mingling with the white wreaths of steam from the hissing engine, wonder whether we are really within the earth or upon it.

Lamps are burning upon the walls, persons are passing through the room in which we are seated, are going down stairs, coming up stairs, bustling in every direction—a new face each minute. We appear to have stumbled among the gnomes. We find in passing through the village that the people here have railroads running in every direction, and, as the world above, have to clear the way for the rushing trains that with fiery eyes dart wrathfully out from dark and lonesome roads. With a "whiz" the cars fly past us and speed away down along what seems one of the dreary lanes to Satan's scooty kingdom—a by-way leading straight into the smoky capital. About us we occasionally hear the splashing of water, mingled with creaking sounds, and pass through places where the air strikes damp and cold upon our cheeks, to enter which is hot and stifling.

Suddenly peals of thunder burst over our heads, and every gallery and cavern echoes its roar. Our nerves are soon quiet, for we know that the noise was but the discharge of a ton of ore through some of the chutes above. There are inhabitants far above us toward the surface of the earth—the place is like a huge ant hill. Again, upon a sudden, our ears are rent by an explosion—above, below, somewhere—which causes us for a moment to suppose that the earth had burst in its centre, and is no longer a thing of substantiality. We know that it was but a blast, which thus caused the whole place to shudder, and smile at our late nervousness. There are many roads leading from Gould and Curry, and we might travel half a mile in several directions, but we will continue our journey northward, and rise to the surface at the works of the Best and Belcher, through a shaft some 400 ft. in depth. Here we land nearly 100 rods north of where we descended.

Our underground railways are being extended daily in every direction, and will soon be connected with those of the Gold Hill mines, and these again with those of the American Flat. In a very few years more there will be miles on miles of these subterranean streets meandering under, and running from one to another of our cities.

TREATMENT OF AURIFEROUS SULPHURETS.—Observing that the difference between the assay value of gold ore and the quantity of gold extracted was not accounted for by the gold remaining in the tailings, Messrs. Crosby and Thompson, of California, have conducted a long series of experiments which have demonstrated that gold, if not volatile, is so nearly so that the practical working of it is the same as if it were. No one will deny that the sulphur carries the gold, and it is observed that these sulphates of iron, by some natural system, are nearer the surface the further north they are found, and the nearer the equator the greater the depth before being reached. In Colorado this iron is 30 to 100 feet more or less from the surface, elevations and disturbances affecting their locality as a matter of course. In this arrangement the ore, after being crushed into a fine powder or sand (this being done in all systems of working gold), and being generally wet is passed through a drying cylinder, some 10 ft. in length and 3 ft. in diameter. The latter revolves on a hollow 6 in. axle, perforated, through which oxygen can be forced in to perfect desulphurisation, caused by heating the cylinders to about 800°, making them a dull red. The cylinders are slightly inclined, just so that their revolutions will carry the ore through; at the outlet the desulphurised ore falls into a receiver, and the vapour passes out also above it. Passing up it is conducted through spray, where it cools, and the gold becomes metal.

HOW TO CLEAN QUICKSILVER.—There are few things which cause more trouble in saving gold than the impurities which often exist in the quicksilver used for amalgamating. These impurities often consist of lead, sometimes of some greasy substance, and often of copper and other metals held in metallic or mineral form. To separate these impurities from the quicksilver has by many been found a difficult matter. We are assured that the cleaning or separating may be readily accomplished by retorting, but in doing so the mercury in the retort should be covered an inch deep with pulverised charcoal. When this is done the vaporised mercury passes through the pulverised charcoal, which at once absorbs all the impurities, and leaves the mercury clean. This method is extensively practiced in some of our mining countries, and is said never to fail in its results. We recommend it to our miners. If any of you doubt, you can easily make the test.—*Colorado Miners' Register.*

GELLERAT'S STEAM ROLLING AND PORTABLE ENGINES.—This invention, patented as a communication to Mr. Henry, the patent agent, Fleet-street, consists of an apparatus, mounted on axles which carry rollers, acting both as propelling and bearing wheels or rollers, and which can be caused to converge or move out of the parallel, in order to turn the engine to either side. Motion is communicated to them by a train of toothed wheels driving a chain-wheel, mounted on the axle-box, and transmitting rotary motion to the bearing-wheels or rollers by a crank arm or short connecting rod jointed to a radial arm of such wheel or roller. The axles are not fixtures, but are suspended in brackets, fitted with friction-rollers, and they are moved by a double-threaded worm, or right and left handed screw, which takes into nuts, and is worked by handle and bevel gear.

CLAVEL'S LAMP-GLASS HOLDERS.—The specification of this patent, recently filed by Mr. Henry, patent agent, Fleet-street, consists in constructing the sockets, holders, or supports for gas and lamp-glasses, or chimneys, adjustible as to size, or extensible and contractible, so that one holder will serve for various sizes of glass or chimney. This is effected by forming the socket or holder with slots, and tightening or loosening it, so as to vary its diameter, either by a conical outer ring, or by an incomplete ring or cylinder, with a break or opening in it, fitted with a screw; or the holder itself may be of the form of an incomplete ring or interrupted cylinder, opened and closed, or tightened or loosened, by a screw. The improvement may be applied to the rings or lower parts of frames or supports fitted round chimneys or glasses of lamps or burners to receive shades or reflectors.

At the Academy of Sciences, M. Collignon read a paper on a method of representing the surface of the earth on a plane, by making one of the poles the common centre of a series of circles representing the geographical parallels. By this system of projection, the deformations of the angles and changes of length may be easily ascertained, and thus, by easy rules and tables, constructed by the author, the real dimensions may be easily determined at each point of the map.—Mr. Reboul sent in a paper on a new carburet of hydrogen, which he calls *calyléne*, and which is composed of ten equivalents of carbon and six of hydrogen. It is obtained by distillation from the bromide of valerylène, treated with an alcoholic solution of potash. The new substance only distils from the latter at a temperature of from 40° to 50° centigrade.—*Galignani.*

ALLOYS OF METALLIC MANGANESE.

IMPORTANT SUBSTITUTE FOR SPIEGELEISEN.

An invention has been patented by Dr. O. E. Prieger, of Bonn, the object of which is to produce alloys which he names respectively ferro-manganese and cupro-manganese, the former of which is applicable as an iron improver, the latter as a substitute for brass. For the production of ferro-manganese, the manganese ores, or substances containing manganese, are crushed to powder, and dried if they contain water, and this powder is well mixed with powdered charcoal, sufficient in quantity for the reduction; or any other reducing carbonaceous substance may be employed instead of charcoal. This mixture is intimately combined with the determined quantity of metallic iron or steel, which may be cast or wrought, in small particles, and in quantity differing according to the different sorts of ferro-manganese intended to be made. The mixture of manganese ores, charcoal, and iron or steel is put into crucibles, by preference of graphite, holding from thirty to fifty pounds, and is well covered in with a layer of coal, flour spar, common salt, or other substance suitable to prevent oxydation from the air. The crucible is then placed in a furnace or stove and exposed to a white heat during several hours; by this the manganese becomes reduced into metal, combines with the melting iron, and this combination, the ferro-manganese, settles down at the bottom of the vessel in a fluid state as a perfectly molten regulus under a greenish slag. In this manufacture the addition of metallic iron or steel is absolutely necessary for the full success of the process and the cheapness of the production of the ferro-manganese. The single particles of the iron take up, while melting, the next small particles of the reduced manganese metal, which latter are difficult to melt, and would not gather together without the presence of the metallic iron. The ferro-manganese thus produced is a thoroughly homogeneous substance, composed equally in all its parts of manganese metal and iron. It is very hard, harder than quartz and hardened steel of any sort, it is brittle and susceptible of polish, has a grey colour, varying from steel grey to silver grey, with metallic lustre; it melts at red heat and fuses with sharp edges; it remains unaltered by exposure to the air for years and does not oxydise, while, by exposure to water, it oxydises only on the surface and does not decompose. By this property it differs greatly from the pure manganese metal, which oxydises by exposure to the air in a short time, decomposing into powder, and which oxydises by exposure to the water in the same way, with a vivid evolution of hydrogen. A very important fact is the thoroughly homogeneous composition of the regulus in all its parts; its structure may be crystalline or granular; the weight-proportions of the manganese metal and the iron are always the same in all parts of the regulus. Thus the quantity of the manganese metal can be regulated in the ferro-manganese in any required proportion, and the inventor has it in his power to add with the ferro-manganese any desired quantity of manganese metal to iron or steel with mathematical exactness, which, as will appear hereafter is, of the utmost importance.

Ferro-manganese is a perfectly metallic substance, hitherto unknown, and containing solely manganese metal and iron with traces of carbon. There are certainly several sorts of pig-iron, especially the spiegeleisen, which contain a small proportion of manganese metal, but in all these sorts of pig-iron the proportion of manganese metal is too small and too uncertain in quantity, and they cannot be compared with the ferro-manganese, in which the manganese metal forms always the prevailing typical part. The ferro-manganese is applicable to various purposes in the arts and manufactures. In the manufacture of iron and steel the addition of a few per cent. of manganese metal, which he does in the form of ferro-manganese from one-tenth to five per cent., increases greatly the hardness and strength of these metals, without altering in the least their other good qualities, such as ductility, tenacity, malleability and welding properties. The steel becomes by the addition of manganese metal more malleable, so that it is malleable in the greatest red heat without getting cracks or faults, which with other steel, for example cast-steel, is not the case, that being malleable only with a dull red heat; in a like manner the steel becomes better to weld. By addition of a small quantity of manganese metal in the form of ferro-manganese, say from one-tenth to two per cent., to the usual charge of the crucibles in the manufacture of cast-steel, it becomes harder and stronger to a certain extent, in proportion to the increased quantity of the added ferro-manganese. By adding a small quantity of manganese metal, from one-tenth to three per cent., in the form of ferro-manganese to the pig-iron in the manufacture of puddled steel, he produces a steel whose tensile strength is from fifteen to thirty per cent. superior to that of the steel manufactured in the same way without this addition. By adding from one to three per cent. of ferro-manganese to the pig-iron in the steel puddling process, he obtains a steel from which chisels and other hard-cutting tools of superior quality have been manufactured. The absolute strength of the puddled steel made with the addition of one-half per cent. to three per cent. of manganese metal to Scotch pig-iron has been determined by a series of experiments on the tensile strength of bars and plates made from it. In these experiments the breaking weight of the plates per square inch varied only from fifty to fifty-four tons (on the average fifty-two tons), whilst the puddled steel made from the same pig-iron without the addition of manganese metal had in its plates only a mean breaking weight of forty tons. He has already produced many tons of ferro-manganese with sixty and eighty per cent. of manganese metal, while hitherto the manganese metal has been produced only in pieces of some drachms weight, and at a cost almost equal to its weight in gold. By this invention the cost of the manganese metal is about the same as that of copper, and its production may be increased to any amount. For producing cupro-manganese the manganese ores are prepared in the same way, and mixed with the same required quantity of charcoal, as has been described for the production of ferro-manganese. To this mixture metallic copper is added, or alloys of copper with zinc or tin may be added in small particles when it is intended to make afterwards alloys of cupro-manganese with these metals, and the entire mixture is reduced and melted down into a metallic regulus in the manner described for the production of ferro-manganese. The cupro-manganese is an easily fusible, hard, tensile, strong, ductile metal; it can be rolled to very thin plates and drawn out to a very thin wire without breaking or tearing. The cupro-manganese has been hitherto quite unknown, likewise its alloys with zinc, with tin and zinc, and with zinc and nickel, of which Dr. Prieger has produced a long series of different compositions, many of which have proved useful for industrial and artistic purposes. Of these he notes especially the alloys of cupro-manganese with zinc, which are fusible, tough, easily to be worked, and in colour and lustre approaching fine silver, and the alloys of cupro-manganese with tin and zinc, which are fusible, hard, and in colour and lustre approaching silver.

The cost of the manufacture of cupro-manganese is about equal to that of brass, to which it is preferable for many purposes, especially by its greater toughness and hardness. He has produced cupro-manganese and many alloys from it in large quantities, and by experiments on a large scale has proved their superior qualities, and their applicability to many industrial and commercial purposes.

EXTRACTING GOLD FROM SULPHIDES.—The experience acquired in Colorado, in connection with the separation of gold from sulphurets, appears to prove beyond question that this class of ore may, with care and judgment, be successfully and profitably treated. The essential conditions to the successful roasting or desulphurisation of sulphurets are the presence of heat and oxygen. If the heat be intense, and the particles of ore be well distributed, so that they can freely absorb oxygen from the surrounding atmosphere, then roasting will be speedy and complete. With the appliances heretofore in use, these conditions could not be fulfilled. The ore being exposed in mass would upon a slight excess of heat melt, thus almost excluding the action of oxygen, owing to the small surface exposed. In this case it is necessary to withdraw from the furnace the melted charge and re-grind it, so as to expose a greater surface. By the Keith process, which is as simple as ingenious, there is a maximum exposure of the ore, every particle of which is desulphurised almost instantaneously as fast as it is introduced into the furnace. Though but little be under treatment at any single moment, the process is continuous, so that is as quantities of ore can be roasted in a remarkably short time. The principles involved in this process are identical with those belonging to the use of the chemist's blow-pipe and lamp. Imagine, then, a huge blow-pipe, with a nozzle 6 or 8 inches in diameter, discharging a continuous stream of air and pulverised pyrites into a flame of a foot or more in diameter; now, enclose this flame in a horizontal or inclined flue connected with collecting chambers and chimney, and the reader will have a good general idea of the process and apparatus. The furnace used at one of the Colorado Mills is thus described:—At one end of a horizontal flue, 20 ft. long and 4 ft. in diameter, with an arched roof constructed of brick, is introduced in a shorter flue or pipe, about 4 ft. long and 20 inches in diameter; the flame from the fire-place enters this shorter flue from the under side, through a properly constructed opening, technically termed a "bull's eye." The pulverised ore is introduced into the furnace by means of a fan-blower, the pipe of which carries a continuous current of air containing the fine particles of ore diffused through it, into the end of the smaller flue, so that the air and ore are passed directly into and with the flame. In this condition many kinds of ores are combustible, burning with an intense heat, filling the larger flue with a flame consisting merely of the particles of ore in an incandescent state. Through the walls of this larger flue small holes are placed at proper distances calculated to admit air, the oxygen of which supports the combustion. The flue is connected with "collecting chambers," the construction of which is suitable for the purpose of settling and collecting as much of the desulphurised ore as possible. From these chambers an inclined chimney is built upon the hill, serving the double purpose of creating proper draft for the furnace and carrying away the acids, gases, and other volatile products arising from the combustion of the ore. The heat furnished by the burning fuel and the burning ore is sufficient to melt the particles of gold present, and as they are melted while in suspension every particle assumes a globular shape. This is a very important item, as particles of gold of that shape are not so liable to remain untouched by the quicksilver as when in a leafy form. The consumption of fuel is very small, being about a cord of wood in 24 hours, during which time from 25 tons to 30 tons of pyrites are desulphurised. This small consumption of fuel is easily accounted for when we remember that the ore in the conditions of the treatment becomes fuel itself, which burning assist in furnishing heat to melt and ignite the particles of ore immediately following. The desulphurised ore is well scoured with buhr stones, and then treated by amalgamation, or by shaking tables of peculiar though simple construction.

WELDING STEEL AND CAST OR MALLEABLE IRON.—Mr. Wm. Carson Corsan, of Sheffield, has provisionally specified the use of a composition, consisting of borax, 50 parts; Calais sand, 30 parts; emery, 10 parts; and manganese, 10 parts, in the welding of steel and cast or malleable iron; but he does not restrict himself to these precise proportions.

HIGH-SPEED COMPRESSED-AIR HAMMER.—Mr. W. D. Grimshaw, of Birmingham, read a paper at the Institution of Mechanical Engineers, descriptive of a High-Speed Compressed-Air Hammer, for planishing, stamping, &c., the objects of which are to obtain a self-acting hammer with a great range in the force and rapidity of the blows, so as to be suitable for light forging, tilting, and planishing; or capable of being worked by hand with heavy blows for stamping, when required; and arranged to be driven by a belt from a shaft, in order to be applicable when direct steam-power is not available. The air is compressed by a force-pump, worked by a crank pin on the driving pulley, and is delivered into the interior of the hammer frame, which forms the reservoir. The working cylinder and piston with hammer are arranged as in an ordinary steam-hammer, but driven by the compressed air, which is admitted above and below the piston alternately by a slide valve, the pressure of the air being regulated by a throttle valve worked by a foot treadle. The slide valve is worked by a crank pin on a horizontal disc wheel, which is driven by friction by contact with a vertical wheel upon the driving pulley shaft of the hammer; this vertical wheel slides upon a feather on the shaft, and is moved by a hand lever nearer to the centre of the horizontal disc, or further from it, thereby altering the speed of working the slide valve, and giving the means of increasing the number of blows of the hammer, without stopping it, up to more than double the rate of revolution of the main driving pulley. By means of a handle the slide valve spindle is readily disconnected whilst at work from the disc that works it; and the valve is worked by a hand lever whenever it is required to use the hammer for stamping. The force, rapidity, and quality of the blow given by the hammer can be changed with great promptness and accuracy; and the hammer is found very advantageous in many situations, such as where there would be a loss of power by condensation in bringing steam from a great distance, or where the damp from leakage of steam or the dropping of condensed water on the anvil would be objectionable, as in planishing bright work. A working model of the hammer was exhibited, and shown in action.

GAS IN LONDON—No. II.

We gave minute details recently of the amounts expended on capital account by the great gas companies of London, and it is time now to review the results attained by the first establishment expenditure incurred. The gross receipts by each company in 1861, 1862, and 1863, from the sale of gas were as follows:—

Company.	1861.	1862.	1863.
Chartered	£207,661	£222,946	£251,220
City of London	81,277	92,376	91,977
Commercial	94,325	103,554	113,170
Equitable	66,053	69,361	69,057
Great Central	61,883	72,485	73,040
Imperial	356,930	397,947	419,000
Independent	58,361	60,659	59,057
London	127,683	133,776	142,004
Phœnix	127,131	136,812	142,975
Ratcliff	27,477	29,033	29,960
South Metropolitan	57,407	61,168	65,727
Surrey Consumers'	46,410	49,292	51,090
Western	62,134	69,189	77,065
Total	£1,374,732	£1,498,570	£1,573,391

These figures are very remarkable, showing as they do the steady progress of the consumption of gas in the metropolis. In 1863 the revenue of the companies did not increase, it will be observed, so rapidly as it advanced in the preceding year. If, however, we compare 1863 with 1861, we see that the revenue of the Chartered advanced in the two years to the extent of 26,559*l.*; that of the City of London, 13,640*l.*; the Commercial, 18,845*l.*; the Equitable, 3574*l.*; the Great Central, 11,157*l.*; the Imperial, 62,070*l.*; the Independent, 1306*l.*; the London, 15,121*l.*; the Phœnix, 15,844*l.*; the Ratcliff, 2483*l.*; the South Metropolitan, 7920*l.*; the Surrey Consumers, 4659*l.*; and that of the Western, 15,271*l.*

The company which increased its business most largely in the two years was thus the Imperial, while the Independent was at the bottom of the list. It may be observed, that the Chartered charged, in 1863, 4s. 6d. per 1000 cubic feet for common gas, and 6s. per cubic feet for Cannel gas; the City of London the same terms; the Commercial, 4s. 5d. per 1000 cubic feet for common gas; the Equitable, 4s. 6d. per 1000 cubic feet for common gas, and 6s. per 1000 cubic feet for Cannel gas; the Great Central and Imperial, the same price for common gas; the Independent, 4s. 6d., and 6s. per 1000 cubic feet for common gas; the London, 4s., 4s. 6d., and 5s. per 1000 cubic feet for common gas, and 6s. per 1000 cubic feet for Cannel gas; the Phœnix, 4s. 3d. and 4s. 9d. per 1000 cubic feet for common gas; the Ratcliff, 4s. 6d. per 1000 cubic feet for common gas; the South Metropolitan, 4s. per 1000 cubic feet for common gas; the Surrey Consumers', 4s. 6d. per 1000 cubic feet for common gas, with discounts varying according to the amount of consumption; and the Western, 6s. per 1000 cubic ft. for Cannel gas. Some reductions have probably since been made. It may be interesting to eliminate from the companies' general receipts for gas, the amounts paid in the three years for public lighting and contracts.

Company.	1861.	1862.	1863.
Chartered	£17,916	£19,071	£19,823
City of London	3,565	4,520	5,897
Commercial	13,509	13,714	13,947
Equitable	7,304	6,502	7,284
Great Central	7,808	6,320	6,866
Imperial	64,934	63,463	64,496
Independent	7,263	6,213	5,705
London	17,914	18,298	19,071
Phœnix	18,174	18,936	19,374
Ratcliff	4,035	4,101	4,102
South Metropolitan	11,060	11,202	11,488
Surrey Consumers'	10,341	10,809	11,309
Western	10,631	10,447	10,707

This branch of the business of the companies showed no great advance, in fact, in the cases of the Equitable, the Great Central, the Imperial, and the Independent, it appeared to be less productive. Another important source of revenue with gas companies is the sale of residual products, which produced in the three years under notice the following sums to each of the undertakings which we are analysing:—

Company.	1861.	1862.	1863.
Chartered	£17,040	£39,550	£36,393
City of London	23,297	21,543	19,110
Commercial	21,393	19,630	20,793
Equitable	13,540	12,091	12,867
Great Central	20,625	18,731	19,365
Imperial	79,317	73,018	71,455
Independent	15,048	15,956	15,617
London	35,454	34,653	22,206
Phœnix	34,556	33,256	33,194
Ratcliff	7,040	6,899	7,093
South Metropolitan	16,419	15,818	15,707
Surrey Consumers'	15,492	12,710	12,998
Western	6,189	6,320	6,529

The slight decline generally observable in the receipts from residual products is attributable to the smaller amounts received for coke, which is the most important and prominent element in this source of revenue. Taking, also into account the amounts derived from the rental of meters, the sale of old materials, &c., we arrive at the following sums as the gross incomes of the various companies in the three years:—

Company.	1861.	1862.	1863.
Chartered	£265,227	£272,115	£281,589
City of London	110,959	111,526	116,274
Commercial	116,251	124,176	134,853
Equitable	87,267	90,680	91,897
Great Central	95,523	108,780	120,908
Imperial	473,844	479,270	502,267
Independent	75,108	78,738	92,817
London	168,072	176,277	194,867
Phœnix	162,192	170,588	176,697
Ratcliff	34,617	36,012	37,247
South Metropolitan	97,473	107,063	113,675
Surrey Consumers'	62,622	63,845	67,587
Western	86,513	77,750	85,184

The general income of the Chartered thus increased in 1863, as compared with that of 1861, to the extent of 16,262*l.*; the City of London, 5415*l.*; the Commercial, 18,602*l.*; the Equitable, 4630*l.*; the Great Central, 25,345*l.*; the Imperial, 28,523*l.*; the Independent, 17,709*l.*; the London, 26,785*l.*; the Phœnix, 14,505*l.*; the Ratcliff, 2630*l.*; the South Metropolitan, 16,202*l.*; and the Surrey Consumers', to the extent of 4913*l.*; the Western decreased, however, to the extent of 929*l.* In another page we must examine a little into the question of working expenses, &c.

NEW CALORIC ENGINE.—A caloric engine, which possesses some peculiarities, has been recently invented in Germany. Its principle consists in pumping atmospheric air into an air-tight furnace, for the support of the fuel which is introduced previously, and must be from time to time renewed. The combustion is effected within a fireplace of refractory clay, surrounded at some little distance by the closed cylinder which constitutes the furnace. The atmospheric air keeps the fuel in a state of such intense ignition that at a pressure of four atmospheres it will fuse wrought-iron, and will change cast into malleable iron; it is at the same time greatly expanded by the high temperature. The gaseous products of combustion, mingled with a small quantity of steam—introduced chiefly with the object of lubricating the pistons—move two pistons of peculiar construction. After doing its work, the heated air passes into the atmosphere perfectly free from smell. There is a great economy in this engine to acquire a very high velocity, since the combustion augments in intensity in proportion to its speed.—*Stockton and Hartlepool Mercury.*

RESPIRATORY APPARATUS.—A series of experiments was made a few days ago, in Paris, with an apparatus, invented by M. Galibert, to enable a man to breathe in the midst of deleterious emanations. A quantity of flour of sulphur was set fire to in a cellar, and a sufficient quantity of sulphurous acid being thus evolved, a fireman, who had never used M. Galibert's apparatus, which is a combination of air tubes communicating with a sort of knapsack filled with compressed air, entered the cellar, and stayed twelve minutes in it, without experiencing any injurious effects. His nostrils during the time were strongly compressed by a sort of spring, and his eyes protected by a pair of spectacles made for the purpose. The man did not leave the cellar until called by his colonel. The cellar was then filled with a dense and acrid smoke, and another man went in with the same success. At length Colonel Willerme himself put on the apparatus, and stayed a considerable time in that atmosphere of suffocating vapours of every description, and convinced himself by his own experience that a man could breathe as freely with the apparatus as if he were in the open air. Similar experiments have been performed at Versailles, and lately in one of the cellars of the Société d'Encouragement. When the air in the reservoir has become foul by the action of breathing, fresh air may be introduced; the knapsack, which is of metal, has a tin bottom, but the lid consists of a skin or leather bag. To drive out the foul air this leather bag has only to be pressed down, and to fill the space with fresh air the bag is pulled up again. To fill a larger space, like that of a goatskin, with fresh air, M. Galibert uses a pair of bellows, a slower process, but better adapted to the size of the recipient.—*Galignani.*

BREAKING ROCKS BY FIRE.—The ancient method of breaking rocks by fire has lately been revived at the Ramme sberg Mine, in the Hartz Mountains. A portable furnace about 1½ bushel of coke burns 18 hours, when the furnace is removed and the rock left to cool, after being sprinkled with water. About noon the face of the rock spontaneously detaches itself, and after that a further portion is broken. The effect of the fire extends to 8 inches, and with 1½ bushel of coke from 1600 to 2000 lbs. weight of ore is obtained at half the cost of the gunpowder process.

THE COAL QUESTION—No. II.

Continuing our reference to the COAL QUESTION,* as argued by Mr. JEVONS, we must admit that the information which he has brought together is well calculated to cause the importance of the subject to be appreciated, and to enable accurate conclusions concerning it to be drawn. He arranges the matter under sixteen headings, and can thus treat it in a thoroughly systematic manner, with great facility. By devoting the first chapter to the explaining of the Opinions of Previous Writers, the extent to which Mr. JEVONS agrees or disagrees with them can be at once ascertained. In considering the Geological Aspect of the Question, the developed coal deposits are defined, and their worked and unworked portions estimated; and reference is then made to the discovery of probable extensions of the now known coal fields, and also of new coal fields in parts of the country where, although no coal has yet been found, the geological age of the rocks being less than that of the carboniferous strata, gives some ground for the opinion that the discovery may yet be made. In connection with this the views of Mr. GODWIN AUSTEN as to the existence of coal measures beneath the cretaceous and Wealden beds of Wilts, Berks, Surrey, and Kent are alluded to, as well as the opposition views of Mr. WHITAKER. It will be recollected that Mr. GODWIN AUSTEN argued that an underground ridge of mountains probably stretched from the Mendip Hills to the Ardennes in Belgium, and he observed—"We have strong *à priori* reasons for supposing that the course of a band of coal measur a coincides with, and may some day be reached along, the line of the valley of the Thames, whilst some of the deeper seated coal, as well as certain overlying and limited basins, may occur along and beneath some of the longitudinal folds of the Wealden denudation." Mr. WHITAKER argues against this, that although some of those old rocks may belong to the coal measures, it does not follow that coal will be found at a workable depth, the coal measures being sometimes without that mineral. Mr. JEVONS concludes that—"All that is shown is a bare possibility of finding coal; but as it is uncertain whether the coal measures are there at all, whether if there they contain good coal, and if so whether they are within workable depth and circumstances, it must still be held very unlikely that coal will ever be got in this tract." Now, that there is anything like certainty of the discovery of a great southern coal field we will not attempt to argue, and we quite admit the justice of Mr. JEVONS' remark, that "we should avoid putting too much reliance upon possible coal fields," yet we think many researches are pursued much less likely to lead to satisfactory and profitable results than that in question. It must be remembered that, in effect, Mr. GODWIN AUSTEN argued, following our old correspondent, Mr. MATTHIAS DUNN, the continuation of the Belgian coal field through our southern counties; and although the amount of research which has yet been made is but limited, the facts which have come to light rather tend to confirm Messrs. DUNN and AUSTEN'S views than otherwise; and even so recently as Feb. 18 we published the abstract of a paper by Mr. G. C. GREENWELL, with diagrams, which, to say the least affords considerable evidence of the probable identity of the deposits.

The Cost of Coal Mining is treated of in the following chapter, and upon this point, again, we are decidedly disinclined to doubt Mr. JEVONS' views as to the existence of commercial as well as moral and physical impossibilities, and we agree with his opposition to Mr. HULL as to the increase of temperature in sinking, and the probable depth to which our collieries may be worked. Mr. JEVONS observes that—"If coal were quarried at the surface, and wheeled straight away, each hewer would scarcely require more than one subsidiary labourer. In a deep mine we find that nearly three subsidiary labourers are required, so that four only accomplish what two would do at the surface, to say nothing of the timber and other materials consumed, and the great capital sunk in the shafts, engines, and works of the deep mines." Here Mr. JEVONS has evidently dropped the substance and caught at the shadow, the part of the question (the employment of additional labourers) to which he attaches the greatest importance being precisely that which will probably remain unchanged. We do not at present take coal from surface deposits, and, therefore, to compare surface coal-digging with the deep mining of the future is calculated to produce most erroneous impressions. We opine that a similar seam of coal could be wrought with as few hands if situated at the depth of 5000 feet from surface as if at 2000 feet, but the expense of sinking the shaft, erecting the necessary engines, &c., would doubtless be greater. Again, we question the accuracy of Mr. JEVONS' assertion, that the management of a deep-lying seam is more complicated than that of a shallow one, although it cannot be doubted that the difficulties increase as the same seam becomes more extensively opened; and we believe that the working of deep seams, if they be discovered, presents no important engineering difficulty.

With regard to the Coal-Cutting Machines, Mr. JEVONS tells us that even in the West Ardsley Colliery, belonging to the patentees of the machinery, who naturally carry out its use to the utmost possible extent, the machine is found to diminish the staff only 10 per cent. The labour saved is only that of 27 hewers, while other branches of the staff must be rather increased than diminished. So different, too, are the conditions of coal mining, that in many collieries the use of coal-cutting machinery is, perhaps, impracticable. Now, whether these statements are open to question it is difficult to say, since Mr. JEVONS does not state whether the reduction in the staff has been made upon the same output of coal. It should be considered, moreover, that machine-hewing requires a somewhat different laying out of the mine, and that hitherto the trials of it have almost invariably been made in places laid out for hand-hewing. We do not see what should necessitate the employment of an increased staff through introducing the machine, unless it be an increased output, and we are thus led to presume that Mr. JEVONS' opinion unfavourable to the machine must be attributed to insufficient consideration of the necessary facts and data.

It is Mr. JEVONS' opinion that "the deeper a mine the more fiery it generally becomes;" but in this he is, we think, unsupported by facts or general opinion, but few regarding depth as having anything material to do with the production of fire-damp; much importance cannot, therefore, be attached to his observation that "Carburetted gas, distilled from the coal, perhaps, in former geological ages, lies pent up in the fissures at these profound depths, and is ever liable to blow off, and endanger the lives of hundreds of persons." He regards 12 in. as the thinnest seam that could ever be worked while the price of coal remains at all tolerable. Coal mining, he says, is a fair fight with difficulties, and just as the balance inclines between the difficulties and the powers we possess to overcome them will the cost of coal and the prospects of this country oscillate. Our industry, he considers, will last and grow until our mines are commonly sunk 2000 or 3000, or even 4000 feet deep; but when this time comes, the States of North America will still be working coal in the light of day, quarrying it, at least in Mr. JEVONS' imagination, in the banks of the Ohio, and running it down into the boats alongside. The question is, he concludes, how soon will our mines approach the limit of commercial impossibility, and fail to secure us any longer that manufacturing supremacy on which we are learning to be wholly dependent?

The cost of coal mining having been thus fully discussed, Price is the next point in connection with the coal question to which Mr. JEVONS directs attention. "The exhaustion of our mines will," he observes, "be marked *pari passu* by a rising cost or value of coal; and when the price has risen to a certain amount comparatively to the price in other countries, our main branches of trade will be doomed." No doubt. But when can this happen, unless some coal-producing country, considerably more favoured than any now known, be hereafter discovered? We recollect at the very college of which Mr. JEVONS is a Fellow hearing the professor of geology—Prof. MORRIS—explain that, considering the relation of area of country to the area of coal fields within them, the United Kingdom was more favoured than any other, the order of importance being, we think, the United Kingdom, America, Belgium, France, Spain, Prussia, Saxony, Russia, and so on; and it must be obvious that a comparatively small rise of price would cause the coal deposits of less favoured countries to be developed, so as to supply the local and neighbouring markets, and thus relieve the drain upon us long before our main branches of trade are doomed. Even in the same chapter Mr. JEVONS gives a table showing the average price of Newcastle coal at nine decennial periods, terminating with 1860, which shows that in 1811 the maximum price was reached, and that since that time the decline has been gradual, until, in 1860, the fall was equal to 40 per cent., as compared with 1811. But these plain facts are, of course, rather too strong for him, as they would prove the fallacy of his views; he prefers, therefore, a solution of them, and becomes very ingenious. He shows that from 1794 to 1860 the prices of about 40 of the chief materials of commerce fell in the proportion of 100 to 62, and concludes that, as coal was 7s. 6d. per ton in 1794, and 9s. in 1860, it follows that comparatively then to the general mass of commodities the *cost* of coal almost exactly doubled. As Mr. JEVONS is nowhere particularly careful in his choice of terms, we presume that by cost in this instance he means price, price being that which is under consideration. To discuss the bearing of the variation in the price in the general mass of commodities, in order to prove that Mr. JEVONS' conclusions are not justified, would be entering further into the region of political economy than would be interesting to the readers of the MINING JOURNAL; we must, therefore, content ourselves with observing that the argument does not appear to us satisfactory, and that it is unfair, in the case of coal, to compare 1794 with 1860, the improvements in the steam-engine at the beginning of the present century having wrought great changes both in the cost and price of coal, for reasons that are obvious.

Passing over the chapter on British Invention, which contains nothing very remarkable, we come to that on the Economy of Fuel, in which Mr. JEVONS explains that, of our total consumption of coal, about one-third is used for domestic purposes, about one-third in our iron manufactures, and the remainder in our factories, furnaces, and machine-shops generally. He appears to attach comparatively little importance to increased economy in our domestic consumption, and continues—"But the economy of coal in manufactories is a different matter. It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to a diminished consumption. The very contrary is the truth." Now, although this opinion is, to a certain extent, true, it cannot be questioned that increased economy in the use of fuel must tend to increase the amount of work to be done with the same amount of fuel, and thus, at least, augment the advantage to be derived by us from our coal deposits. In this chapter he gives a very interesting table, showing the gradually increasing duty obtained from steam-engines during the past century, showing that in 1859 we were able to obtain 15 times as much power from a given quantity of fuel as was obtainable in 1769.

With respect to Substitutes for Coal, Mr. JEVONS appears to think that a substitute is impossible, and regards all hope of the utilisation of electricity as equal only in absurdity to the hope of obtaining perpetual motion; and in the succeeding chapter, on the Natural Law of Social Growth, referring to the difference between agriculture and mining, he observes that "there is this most serious difference to be noted: a farm, however far pushed, will, under proper cultivation, continue to yield for ever a constant crop, but in a mine there is no reproduction, and the produce once pushed to the utmost, will soon begin to fail, and sink to zero. So far, then, as our wealth and progress depend upon the superior command of coal, we must not only stop—we must go back." After discussing our consumption of coal, he concludes that the check to our industrial progress must become perceptible considerably within a century from the present time, that the cost of fuel must rise, perhaps within a lifetime, to a rate threatening our commercial and manufacturing supremacy, and regards it as an inevitable conclusion that our present happy progressive condition is a thing of limited duration. He contends that the exact amount of our stock of coal is not the matter of chief moment, and that the reader who thoroughly apprehends the natural law of growth or multiplication in social affairs, will see that the absolute quantity of coal rather defines the height of wealth to which we shall rise, than the period during which we shall enjoy either the growth or the climax of prosperity. Such assertions as these being simply the expression of an individual opinion, incapable of proof at present, must, of course, be taken for what they are worth. But where Mr. JEVONS' statements are capable of comparison with facts, we are sometimes compelled to draw different conclusions to his. For example, alluding to the probable lack of underground hands, he states that facts utterly negative such a notion. Here he should have stated what facts he alludes to, the mere calculation of the increased number of miners employed out of the whole population, without reference to anything else, proves nothing; and the fact, well known to all connected with the coal trade, remains—that there is an increasing difficulty in obtaining underground labour upon similar terms to formerly.

Alluding to the Export of Coal, Mr. JEVONS tells us that it has been suggested by many random thinkers that when our coal is done here we may import it, as we import so many other raw materials, from abroad, but maintains that "the least acquaintance with the principles of trade, and the particular circumstances of our trade, furnishes a complete negative to all such notions, while the export of coal is a vast and growing branch of our trade a reversal of the trade and a future return current of coal is a commercial impossibility and absurdity," his opinion being that the reversal of every other branch of trade is the work of coal, and that the coal trade cannot reverse itself. He urges that the coal exported acts as a makeweight to remedy, in some degree, the onesided character of our trade. Coal is to us that one great raw material which balances the whole mass of the other raw materials we import, and which we pay for either by coal in its crude form or by manufactures which represent a greater or less quantity of coal consumed in the steam-engine or the smelting-furnace. To import coal as well as other raw materials would be against the essentially reciprocal nature of trade. The weight of our inward cargoes would be multiplied many times, and but little weight left for outward carriage, almost every influence which now acts, and has for centuries acted, in favour of our maritime and manufacturing success would then act against it, and it would be arrogance and folly indeed to suppose that even Britain can carry forward her industry in spite of Nature, and in the want of every material condition. In our success hitherto it is to Nature we owe at least as much as to our own energies.

In succeeding chapters, Mr. JEVONS discusses the Coal Resources of Different Countries, the Iron Trade, the movement of the iron trade from the former iron-producing districts of Sussex, and the neighbouring counties, to Ireland, and thence back to the coal districts of England, according to the variation in the supply of fuel, and discoveries in connection with manufacture being pointed out in a very interesting manner. He then proceeds to the consideration of the Problem of the Trading Bodies, and remarks that we ought not to forget that the enjoyments of a commercial country are not without probable drawbacks. We are no longer independent. The rise and decadence of other trading nations is no longer a matter of indifference to us. Our profits depend upon comparative, not absolute riches, and, as an individual nation, we may find harm in foreign wealth. And our anxiety must be indefinitely increased in reflecting that while other countries mostly subsist upon the annual and ceaseless income of the harvest, we are drawing more and more upon a capital which yields no annual interest, but once turned to light, and heat, and force is gone for ever into space, Mr. JEVONS regards wholesale emigration as an immediate remedy, but remarks that after a certain period emigration will begin to have a very different effect upon the destinies of this country from that it now exercises. Instead of extending across the seas an agricultural system in harmonious union with our own manufacturing system, it will develope, or rather complete, abroad systems of iron and coal industry in direct competition with ours. The process will be of a two-sided nature.

Upon the question of Taxes and Restrictions on the Coal Trade, Mr. JEVONS entertains the opinion that the taxation of coal would be undesirable, and he says that the only suggestion he can make towards compensating posterity for our present lavish use of cheap fuel is that the National Debt be paid off, which he proposes to do by investing the succession and legacy duties in Consols, and handing over the proceeds to the Commissioners; and at the end of his chapter of Concluding Reflections, which will not be reached until the reader has derived a large amount of information both interesting and instructive, he remarks that our empire and race already comprise one-fifth of the world's population, and by our plantation of new states, by our guardianship of the seas, by our penetrating commerce, by the example of our just laws and firm constitution, and, above all, by the dissemination of our new arts, we stimulate the progress of mankind in a degree not be measured. If we lavishly and boldly push forward in the creation and distribution of our riches, it is hard to overestimate the pitch of beneficial influence to which we may attain in the present. But the maintenance of such a position is physically impossible. We have to make a momentous choice between brief greatness and longer continued mediocrity.

* "The Coal Question: an Enquiry concerning the Progress of the Nation, and the Probable Exhaustion of our Coal Mines." By W. STANLEY JEVONS, M.A., F.U.C.L., F.S.S. London and Cambridge: Macmillan.

THE COAL-BASIN OF NEW SOUTH WALES.—Mr. E. H. Birkenhead, F.G.S., of Worsley Mesnes, Wigan, writing to the "Geological Magazine," says—"I have received a letter from my friend, Mr. John Mackenzie, Examiner of Coal Fields to the Government of New South Wales, from which I extract the following (Mr. Mackenzie is stationed at Wollongong):

'I have had a journey of upwards of 300 miles for the purpose of seeing whether the Hartley coal seams, in the county of Cork, belong to the same coal basin as that of Newcastle and Wollongong; and to see if I could find out with which known seams of coal on this side they were identical. I was able to recognise them. Another reason for my going was, that I had an idea that I could find coal identical with the Fitzroy coal at a distance of thirty miles from Sydney, the metropolis of New South Wales. I have satisfied myself that coal will be found there; but I must make another examination before I can tell whether there is a good seam of coal. I have found the lower coal, which is inferior; and I cannot yet tell whether it will be near enough from the edge of the coal basin for the next excellent seam of coal to come in above it. The coal measures I find gradually increase in their thickness from the edge of the coal basin towards the centre; and the Sydney, or Clarke's Hawkesbury, sandstone rests on the coal measures near the edge of the basin; whilst, near the centre of it, it is 900 ft. from the top coal; sandstones and shales, different in nature from the Hawkesbury sandstone, intervening in the 900 ft. It has been supposed by other geologists that it would always be from 900 to 1000 ft. from the Hawkesbury sandstone to the first coal; whilst I am certain that I can find it, only thirty miles from Sydney, at a depth of from 150 to 200 ft. But if I go to twenty-eight miles, and find the coal coming in, it might be 400 ft.' After giving an account of the great difficulties attending the exploration, Mr. Mackenzie continues:—'I will first give you an outline of what I know from my own exploration of this vast coal field. I have explored the counties of Canada, Cumberland, Cork, Hunter, Northumberland, and Durham, and find that the New South Wales coal basin extends under the whole of them, and a portion or the whole of Gloucester (I have not explored the whole of it), as well as a portion of the counties of Brisbane (not Brisbane in Queensland), Phillip, Roxburgh, Westmoreland, and St. Vincent; and that the south-easterly and easterly side of the coal basin lies partly buried under the Pacific Ocean, and principally washed away. This makes the New South Wales coal basin at least 200 miles in length, and probably the same in breadth; but the breadth can never be ascertained, owing to the easterly side of the basin being in the Pacific Ocean.' Mr. Mackenzie was the discoverer of a magnificent seam of coal (12 yards or more) in New South Wales, not long since."

VICINAL RAILWAYS IN FRANCE.—The first vicinal railway was that proposed in 1858, by M. Migneret, prefect of the Bas-Rhin, who first attempted to organise, from the resources of the country high-roads, a new group of roads of the same class, connecting the several chief towns of the cantons with the lines of railway already executed, and so constructed as to be able to be handed over to companies, or local industrials, for the purpose of being converted into railways. Several objections and difficulties were raised to this system. Some doubted the legality of applying the funds of the high-roads to the construction of roads hereafter to be transformed into railways, or considered the idea as a mere dream. [This called forth a remark of the Marquis de Fleury, prefect of the Vosges, "Si nous rêvons," said he, "C'est du moins en bonne compagnie."] Others fancied that the necessary constructions, such as bridges, culverts, &c., would be prejudicial to agriculture, and that the whole country would become an inextricably tangled network of railways. In spite of all this opposition, however, M. Migneret, strengthened by his own conviction and zeal, did not slacken his labours till they were crowned with success. An extraordinary meeting of the Council General of the Bas-Rhin was held in March, 1859; the classification of these lines proposed to be surveyed was approved, and on June 16 following the department was authorised by a law to impose an extraordinary tax of 26 centimes (about 2¼d.), spread over the years 1861 to 1871. The works were commenced forthwith, and on September 25, 1864, the first 38 kilometres (24 miles) of the vicinal railways were opened for traffic, the total length of this group being 49 miles. This commencement of a new era in the railways of France at once awakened the Government, who perceived in it a step towards removing that great drawback to the development of the mineral and industrial wealth abounding on the Continent—the absence of safe, ready, and economic means of communication and transport. No time was lost in preparing an Act of Legislature, which, more complete than that for ordinary high-roads, and less rigorous than that which regulated the construction of railways, would facilitate the establishment of these lines, without depriving the population of the desirable guarantees of safety. The example shown by the Bas-Rhin has not been lost upon the rest of France. On Dec. 18 following the opening of the vicinal lines in the Bas-Rhin, the department of the Haut Rhin opened a branch line from Haguenau to Niederbronn, and on the 29th of the same month another line from St. Marie aux Mines to Schlestadt. The department of the Sarthe has not only voted funds for the surveys of branch railways, but has levied on itself a voluntary rate, to be expended in the construction of three vicinal roads to be converted into railways. The departments of Ain, La Haute Marne, Cote d'Or, Soane et Loire, Indre, Bouches du Rhone—in fact, all are following the example of the Bas-Rhin. In the Seine Inferieure surveys are being made for connecting the town of St. Valery-en Coux with the Rouen and Havre line, this forming portion of a plan, conceived with admirable intelligence, of uniting by railway all the small ports of the littoral with the principal line from Paris to Havre. In the laying out of these vicinal railways the questions of curves and gradients are not of so much importance as in the principal lines, owing to a high rate of speed not being required. In the report of the agent-voyer (inspector of highways) of the arrondissement of La Châtre (Indre), on the project of establishing a branch line from Châteauroux to La Châtre, the curves of the loop lines joining on to the great railways are not to be of less radius than 15 chains, and in the Haute Marne the curves in the course of the vicinal lines are not to be of less radius than 12½ chains. The maximum gradients in the Haute Marne are from 1 in 55 to 1 in 50, and those in the Indre do not exceed 1 in 67. The earthworks are, consequently, very much reduced in this system of railway; also, the expense of fencing and enclosing the line disappears almost completely, especially when horse traction is used. By these reductions, and the absence of any specially constructed plant, the cost is very low. In the Bas-Rhin the cost was 2897*l.* per mile for the portion charged to the department and the commune, while the sum incumbent on the Eastern Railway of France, the concessionists of the lines, is 3862*l.* per mile; in all, 6759*l.* per mile. In the Haute Marne the cost was 3605*l.* per mile for placing the highways in a fit state to be converted into railways, and 4506*l.* per mile for permanent way and a set of rolling stock: total, 8111*l.* per mile. Comparing these two results with the cost of ordinary railways, we can easily see the possibility of establishing a great number of secondary lines, which will bear the same proportion to the great railways as ordinary parish roads do to our turnpike-roads. The results of the working of the Bas-Rhin vicinal railways have been satisfactory. The receipts of the first three months, ending Dec. 31, are 2939*l.* 10s., which gives for twelve months, even supposing no increase to take place in the traffic, 11,758*l.* This, for 23·6 miles, is at the rate of 498*l.* per mile per annum. The nett profit on the capital expended is ascertained to be about 2000 frs. per kilometre, or 129*l.* per mile, so that the vicinal lines are a success financially. One fact worthy of remark in the working of the Bas-Rhin Railway is that on the 38 kilometres (23·6 miles) there are fifteen stations, one for each commune. In the first three months 70,000 passengers had been conveyed, the receipts being 2411*l.* 14s., or about 8·27 penny per passenger. This plainly demonstrates the class of persons benefitted by these means of communication, and the short distances they required to travel.

FACTORY CHIMNEYS.—Mr. Peter Carmichael has recorded a series of interesting experiments for ascertaining the best size for factory chimneys, in a paper read at a recent meeting of the Institution of Engineers in Scotland. He observes that the importance of an effective chimney need only be named. On it depends in a great measure the success of the firing, so as to raise steam quickly and keep it up steadily, and also the perfect combustion of the fuel with the least amount of smoke. With a draught in the chimney less than 5-10ths on the pressure gauge, the firing of the furnaces will in most cases be a constant toil to the fireman. He cannot avoid making a large quantity of black smoke, and in cases of an extra demand for steam it is impossible to meet it, for no stirring or coaxing of a fire will make it burn brightly, or produce the red glow which is the perfect condition for raising steam, without a full command of draught. His experience is, that most factory chimneys are too large for the work they have to do; not too high (they can hardly be that), but too wide, especially at the top. In their practice, invariably as more boilers and furnaces have been added to a chimney the draught has been improved, and it is obvious that if the opening in the chimney be too large compared with the whole of the openings in the dampers passing into it the draught will be reduced. Hence it is very noticeable in many chimneys, which are large in proportion to the number of furnaces they serve, or the coals consumed, or where a new chimney is put up to serve for prospective additional furnaces, the smoke issuing from such has a very lazy ascent, and they are generally blackened a long way down from the top by the smoke, for when a breeze is blowing the smoke, instead of ascending, falls down the leeward side of the chimney, and clings to it like a ragged black flag. From observations, frequently repeated and tried under various circumstances, it has been found that the temperature is nearly uniform at 600° behind the dampers. He builds his chimneys in the form of an obelisk. The taper top is found to answer the purpose well, the smoke ascending from it very freely, especially when there is a breeze of wind. At such times the ordinary top is acted on like a key when blown into to make it whistle, the blasts of wind affecting very perceptibly the draught of the furnaces. In the taper top this is not much felt, as the wind can only blow into one or two of the four compartments at a time, and this still allows the other two to vent freely. The greatest want of draught is occasionally on Monday mornings, after a cold wet Sunday. In such cases the flues and chimney are cooled down, and the draught greatly reduced, so that the firemen have much difficulty in getting the fire to burn brightly, and keep up the supply of steam. Sometimes, in the setting of the boilers, and even in the chimneys, there are open joints, which admit cold air, and are very injurious to the draught; and the openings for dampers working in are often very wide, and admit more cold air than need be. The draught guage is very useful in detecting any falling off from such causes, and in the hands of the skilful engineer should in some small degree be like the steam-engine indicator. The importance of the chimney and of the draught may seem to have been made too much of in this paper, and certainly it is quite possible to pass too much air through a furnace, and so lower the temperature as to evaporate less water from the same amount of coal. But the error is rarely on this side, and, if so, it can be easily cured by lessening the opening at the flame-wall, or it might be said by partially closing the damper; but there is a great difference in the economy of the two things, as has been found by repeated experiments. With an open throat at the flame-wall a good draught may be got and plenty of coals consumed, but the evaporation of water is woefully deficient, and closing the dampers does not remedy this. It seems that with a narrow opening at the flame-wall, just sufficient to do the work, the greatest amount of heat or the highest temperature is got in the furnace, and the gases passing over the narrow throat are more perfectly consumed and utilised. This is a nice point, although it is frequently not attended to.

MINING IN MEXICO.—A letter from Mexico, dated March 20, says that the present position of that country is more hopeful than it has been for many years. Agriculture had suffered to an alarming extent; and mining operations, which from the peculiar circumstances of the country necessitate the employment of an immense number of animals, and are consequently dependent upon agriculture for a supply of fodder, were in many cases abandoned altogether, and in very few carried on at a rate which left any considerable profit to the owners. In Mexico water is so scarce, and fuel in most parts of the country, where there is neither wood nor coal, so dear, that except in such cases as Real del Monte, all the machinery in use in the mines is worked by mule power, and the mules, in common with the inhabitants of the country, subsist on maize, so that a rise in the price of maize falls with peculiar severity upon the workers of mines. For whereas the producers of other commodities can raise the price of the article produced in proportion as the cost of production increases it is not in the power of the miners to raise the price of the precious metals.

OPPOSITE MOTIONS OF THE EARTH AT THE POLES.—To give a clear illustration of the motion of the earth at the poles, it will be necessary to take in hand a small globe, and bring the poles to a horizontal position by giving the globe a motion from west to east, and at the same time bringing the equator to the horizon. Here we find (say at the north pole) a left-hand horizontal motion. We now turn the globe, still keeping up the motion, so as to bring the south pole vertical; here at this pole we find a right-hand horizontal motion directly opposite the motion just witnessed at the north pole. We never have seen these ideas advanced by philosophers, but this simple experiment will satisfy the most sceptical that opposite motions exist at the poles.—F. D. SPALDING.—*Scientific American.*

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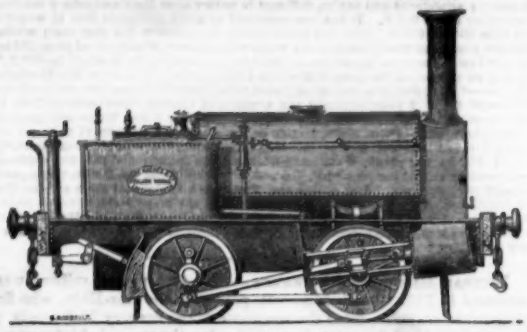

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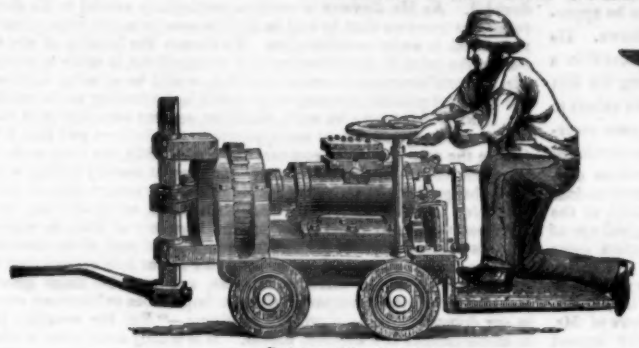
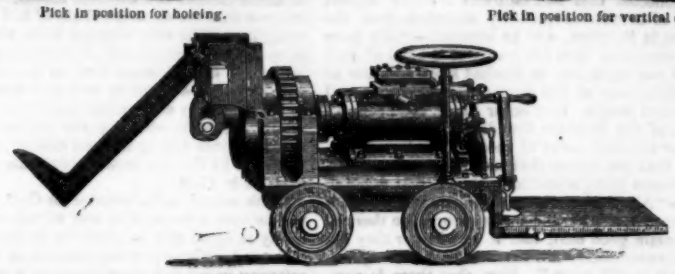


Pick in position for holeing.

Pick in position for vertical cut downwards.



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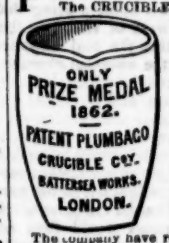

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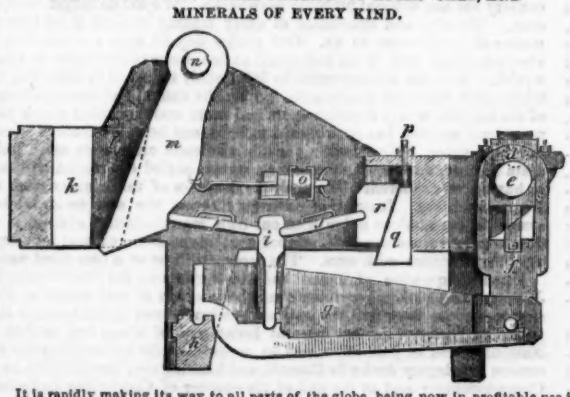

It is rapidly making its way to all parts of the globe, being now in profitable use in California, Washoe, Lake Superior, Australia, Cuba, Chili, Brazil, and throughout the United States and England.

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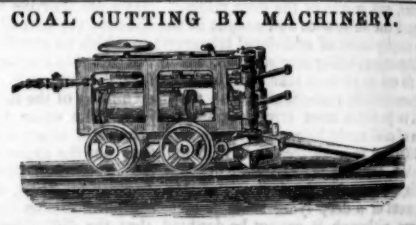
COAL CUTTING BY MACHINERY.



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